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Effect of Different Potting Media on Survival and Growth of Air Layered Litchi cv. Dehradun

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A B S T R A C T

The present investigation entitled "Effect of different potting media on survival and growth of air layered litchi cv. Dehradun" was carried out at the Advanced Centre for Horticulture Research, Udheywalla, SKUAST-Jammu during 2018-19. Different potting media (litchi orchard soil, sand, FYM, sawdust, vermicompost, rhizobacteria, cocopeat, perlite, neem cake and vermiculite) were used in combination with application of 500 ppm IBA. The results showed that among the different media, litchi orchard soil in combination with FYM and rhizobacteria was identified as best potting media for mass propagation of litchi in black polyethylene bags under open field conditions for obtaining highest survival percentage (93.51 %) and also gave better results with respect to all the parameters studied including increase in plant height (10.25 cm), shoot length (12.32 cm), shoot diameter (0.24 cm), length of longest shoot (16.62 cm), number of shoots per layer (6.20), fresh weight of shoot (46.49 g) and dry weight of shoot (28.29 g) after six months of planting. Similarly, the maximum per cent rooting (87.57 %), root length (9.05 cm), fresh weight of root (3.60 g), dry weight of root (1.29 g), partitioning coefficient of root (3.51 %), root: shoot ratio (0.05), maximum number of leaves/ layer (30.60), chlorophyll content of leaves (45.96 %), total leaf area (881.89 cm^2), total dry weight of plant (36.26 g) and relative growth rate (1.48 mg/days) were observed in the media containing litchi orchard soil in combination with FYM and rhizobacteria. The maximum fresh weight, dry weight and partitioning coefficient of leaves (32.00 g, 7.06 g and 21.18 %, respectively) was obtained in media containing litchi orchard soil along with FYM and vermiculite. From the above studies, it can be concluded that the potting media containing litchi orchard soil along with FYM and rhizobacteria was found to be most suitable for survival and growth of air layered litchi cv. Dehradun.

Introduction

Litchi (*Litchi chinensis* Sonn.) is one in all the foremost necessary subtropical evergreen fruit crops belongs to Sapindaceae family; comprising about 125 genera and more than 1000 species. Fruit plants are propagated either by sexual (seed) or vegetative means and litchi is propagated by vegetative means which includes air layering, budding, grafting and cuttings. Production of quality planting material with vigorous growth is initiative in achieving production and productivity in litchi (Kumar *et al.*, 2014). Massive scale

cultivation of appropriate cultivars is constrained by the absence of easy and reliable clonal propagation methods and therefore, the use of contemporary techniques like micro propagation is not terribly productive in litchi (Amin *et al*., 1996). Indiscriminate use of planting material from unreliable source and its substitution for good quality planting material has resulted in low production and productivity (Wahab *et al*., 2001). There is terribly low success rate with grafting and cuttings (Abutiate and Nakasone, 1972) and incompatibility between stock and scion is additionally pronounced in litchi (Mergen, 1954). Low rooting potential, high transplantation shock and poor field establishments are other factors that contribute to low rate of production of quality planting materials (Kumar, 2012). Litchi seeds have awfully short viability and begin losing their germinating capability in less than 5 days (Sauco and Menini, 1989) andare solely used as rootstock for grafting and for research and breeding purposes (Sauco*et al*., 2018).

Air layering or marcottage, is the most widely adopted commercial method for propagation of litchi (Menzel, 1985) but operational period is restricted to few months (monsoon season) at the moment, which is insufficient to get adequate amount of planting material to satisfy the growing demands of genuine planting material (Reang *et al*., 2018).

Propagation of healthy, vigorous and genuine planting material is a combination of art and science, which require correct potting media with advanced techniques and technological skills.

Generally, the nursery bed soil or poly baggage mixture has poor nutrient content and transplanted saplings become weak in few months of its transplantation. Saplings lose their vigour due to improper potting medium and even weak air-layers did not establish within the main field (Kumar *et al*., 2014).

In Jammu and Kashmir, the demand for planting material of litchi has been increasing thus, there is pressure to ensure supply of quality planting material. Nonetheless, the foremost bottleneck related to this methodology of propagation is variable degree of success of air layering, the high mortality of layers once detached from the mother plant and institutions of their own root system in nursery. Thus, it restricts the provision of propagules of elite genotypes of litchi (Sharfuddin and Husain, 1983 and Sharma *et al*., 1990).

It was absolutely determined that use of appropriate growing medium helps in the production of quality planting material with better root system of air-layers and enhanced final survival of litchi air layers within the nursery. This further helps in lowering the cost of planting material that successfully, is going to be helpful for the farmers. Therefore, keeping in view the above facts, the present study was undertaken to study the effect of different potting media on survival and growth of litchi air layers cv. Dehradun.

Materials and Methods

The present investigation was carried out at the Advanced Centre for Horticulture Research, Udheywalla, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during 2018-19. Altogether twelve different treatments viz. Potting media M_1- Soil + Sand + FYM (1:1:1), M_2- Litchi orchard soil + Sand + FYM (1:1:1), M_3- Litchi orchard soil + Sawdust+ FYM (1:1:1), M_4- Litchi orchard soil + Sawdust + Vermicompost (1:1:1), M_5- Soil + FYM (1:1) + Plant growth promoting rhizobacteria (PGPR) @50g/kg, M_6- Litchi orchard soil + FYM (1:1) + Plant growth promoting rhizobacteria (PGPR) @50g/kg, M_7- Litchi orchard soil + Neem cake + FYM (1:1:1), M_8- Litchi orchard soil + Perlite + FYM (1:1:1),

M_9- Litchi orchard soil+ Cocopeat + FYM (1:1:1), M_{10}- Litchi orchard soil + Vermiculite + FYM (1:1:1), M_{11}- Litchi orchard soil, M_{12}- Control (soil) were prepared after thorough mixing of the ingredients at the experimental farm. Litchi orchard soil was collected from 10-15 cm depth from old litchi plants. The prepared mixtures of the various growing media were field in plastic polybags (30 x 20 x 15 cm^3) and kept in open field conditions. Half of the bags were filled with mixtures before planting and remaining half portion was filled after putting the air-layers in middle portion and compress from the side for complete contact with mixtures and water immediately with watering can. Light irrigation was given 3-4 times daily to maintain the proper humidity in open conditions. In each treatment, there were 20 number of air layers were arranged in Randomized Complete Block design with three replications and altogether 60 air layers in each treatment were raised for six months. Sufficient number of uniform size air layers was propagated during 2nd fortnight of July from the mother plants of litchi cultivar Dehradun by adopting the standard procedure. The rooted air layers were detached from the mother plants during 2nd fortnight of October and transplanted in polybags containing different potting media. All due care was taken to raise healthy and vigorous seedlings. Need based inter-culturing, hoeing and plant protection measures were adopted for raising healthy and vigorous seedlings. Observations on growth parameters such as increase in plat height, shoot length, length of longest shoot, shoot diameter, number of shoots per layer, per cent rooting, root length, root diameter, root: shoot ratio, number of leaves per layer, total leaf area, chlorophyll content of leaf, total dry weight of plant, fresh and dry weight of shoot, root and leaf and partitioning coefficient to plant parts were recorded at 15 days interval for six months. Survival percentage and relative growth rate of plants were also recorded after six months of transplanting of rooted layers.

Results and Discussion

Shoot characteristics

Results (Table 1) revealed that growth of litchi air-layers in terms of plant height, shoot length, shoot diameter, length of longest shoot, number of shoots per layer, fresh and dry weight of shoot were significantly higher in media having litchi orchard soil in combination with rhizobacteria and FYM. This might be due to the addition of rhizobacteria which enhances the availability and uptake of plant nutrients, the production of growth promoting substances and the suppression of deleterious bacteria which might have encouraged the rooted layers to put on better vegetative growth and hence, resulted an increase in shoot characters. Enhanced microbial activity in the plant rhizosphere could have the acquisition of mineral nutrients either directly via mobilization or via effect on root morphology and physiology (Babalola, 2010; Dobbelaere *et al*., 2003; Vessey, 2003; Lucy *et al*., 2004; Compant *et al*., 2005). Kumar *et al.,* (2014) stated that the poor growth performance of air layers in control could be due to insufficient organic matter content and moisture holding capacity of the growing medium. These results are in accordance with the findings of Das *et al.,* (2006) in sapota and Putulndriyani (2011) in pineapple.

Root characteristics

The maximum root length, fresh and dry weight of roots was reported in media containing litchi orchard soil in combination with FYM and rhizobacteria. Lucy *et al.,* (2004) had shown that IAA-producing plant growth promoting rhizobacteria increased the roots growth and root length in plants. Rapid

elongation and division of the cells modifying the physiological process supports the faster root growth in terms of number, length and weight (Pandeyand Singh, 2009). A combined inoculation of arbuscular mycorrhizal fungus and plant growth promoting rhizobacteria significantly enhanced root length in red pepper (Kim *et al*., 2010). Plant growth promoting rhizobacteria acts as biofertilizers by directly helping to provide nutrient to the host plant or indirectly by positively influencing root growth and morphology or by aiding other beneficial symbiotic relationships (Vejan *et al*., 2016). Fan *et al.,* (2011) also reported that the presence of arbuscular mycorrhizal fungus significantly changed root morphology and increased root length percentage in strawberry.

Leaf characteristics

Highest number of leaves and increase in total leaf area per rooted layer (30.60cm^{2}and 509.22 cm^2, respectively) and highest chlorophyll content (45.96 %) were recorded inlitchi orchard soil along with rhizobacteria and FYM whereas, the lowest number of leavesand increase in total leaf area per rooted layer (18.47cm^2 and 152.10 cm^2, respectively) were recorded in control. The reason for greater leaf number in media containing litchi orchard soil along with rhizobacteria and FYM is due to greater shoot number per layers (Urmi *et al*., 2016) as well as the availability of more mineral nutrients and efficient absorption by vigorous root system. The increased growth of inoculated plants might be due to the higher N accumulation by bacterial nitrogen fixation and better root growth, which may have promoted greater uptake of water and nutrients. The higher N incorporation apparently increased the formation of protein and enzyme for better physiological activities and also to the formation of chlorophyll, which consequently, increased the photosynthetic activity (Mia *et al*., 2005).The media activated shoot growth which may have resulted in elongation of stem and leaves through cell division accounting in higher number as well as weight of leaves.

Partitioning coefficient

Partitioning coefficient of shoot was maximum in control which indicates that the maximum photosynthates were translocated in shoot which shows that the plant is emphasizing on shoot growth instead of root and leaf growth which are the primary requirement for establishment of transplanted air layers in growing media. While the partitioning coefficient to root and leaf were significantly higher in litchi orchard soil along with rhizobacteria and FYM which shows that the media combination is good for nursery plants as it forced the plants to root production, hence, maintains the source-sink relationship.

Root: shoot ratio

Maximum root: shoot ratio(0.05)was recorded in media containing litchi orchard soil along with rhizobacteria and FYM and minimum root: shoot ratio(0.02) was observed in control. The increased root length and total growth by rhizobacteria application probably resulted in greater root surface area which may have enabled the plant to access more nutrients from the soil and the rooted layers were benefited by the improved root development with subsequent increase in rates of water and mineral nutrient uptake thereby, resulted in an increase in root: shoot ratio on dry weight basis (Chawla, 2011). Kumar *et al.,* (2014) also stated that this could be due to better nutritional availability leading to higher production of photosynthetic leaves in these treatments, finally higher accumulation of photosynthates in morphological growth components. Thus, the air-layers showed higher vigor in terms of sapling height, number of leaves, girth and total plant biomass**.**

Table.1 Effect of different potting media on plant height and shoot characters of air layered litchi plants cv. Dehradun

Treatments	Increase in plant height (cm)	Increase in shoot length (cm)	Increase in shoot diameter (cm)	Length of longest shoot (cm)	Number of shoots per layer
M_1 : (Soil + Sand + FYM)	5.78	5.90	0.05	10.16	3.47
M_2 : (Litchi orchard soil + Sand + FYM)	6.07	8.53	0.08	12.67	4.40
M_3 : (Litchi orchard soil + Sawdust + FYM)	7.02	8.25	0.09	12.32	4.67
M_4 : (Litchi orchard soil + Sawdust + Vermicompost)	6.13	8.52	0.09	12.63	4.53
M_5 : (Soil + Rhizobacteria + FYM)	9.43	11.63	0.20	15.65	6.00
M_6 : (Litchi orchard soil + Rhizobacteria + FYM)	10.25	12.32	0.20	16.62	6.20
M_7 : (Litchi orchard soil + Neem cake + FYM)	7.38	7.01	0.24	11.42	4.73
M_8 : (Litchi orchard soil + Perlite + FYM)	8.31	10.45	0.10	14.76	5.87
M_9 : (Litchi orchard soil + Cocopeat + FYM)	9.31	10.27	0.10	14.53	5.87
M_{10} : (Litchi orchard soil + Vermiculite + FYM)	8.71	10.59	0.10	14.64	5.53
M_{11}: (Litchi orchard soil)	6.02	8.18	0.08	12.63	4.40
M_{12} : (Control)	4.94	5.24	0.03	9.45	3.27
C.D. $_{(0.05)}$	1.38	1.64	0.03	1.59	0.22
S.E (+)	0.47	0.56	0.01	0.54	0.08

Table.2 Effect of different potting media on fresh and dry weight of air layered litchi plants cv. Dehradun

Treatments	**Fresh weight**				**Dry weight**			
	Shoot	**Leaves**	**Root**		**Shoot**	**Leaves**	**Root**	**Plant**
M_1 : (Soil + Sand + FYM)	41.70	21.79	1.26		20.38	3.66	0.54	24.58
M_2 : (Litchi orchard soil + Sand + FYM)	42.68	22.71	2.15		22.82	4.46	0.66	27.94
M_3 : (Litchi orchard soil + Sawdust + FYM)	42.75	22.08	2.13		23.46	4.61	0.73	28.80
M_4 : (Litchi orchard soil + Sawdust + Vermicompost)	43.54	23.92	2.30		23.74	5.09	0.76	29.58
M_5 : (Soil + Rhizobacteria + FYM)	45.57	26.91	2.85		27.36	6.51	1.06	34.93
M_6 : (Litchi orchard soil + Rhizobacteria + FYM)	46.49	25.90	3.60		28.29	6.68	1.29	36.26
M_7 : (Litchi orchard soil + Neem cake + FYM)	42.74	22.00	2.31		24.34	4.38	0.86	29.59
M_8 : (Litchi orchard soil + Perlite + FYM)	43.44	23.89	2.36		25.63	5.16	0.82	31.61
M_9 : (Litchi orchard soil + Cocopeat + FYM)	44.86	27.21	2.35		24.91	6.90	0.94	32.75
M_{10} : (Litchi orchard soil + Vermiculite + FYM)	45.26	32.00	2.46		25.36	7.06	0.90	33.32
M_{11}: (Litchi orchard soil)	42.75	22.31	2.16		22.55	4.63	0.63	27.81
M_{12} : (Control)	40.28	15.92	1.06		19.15	2.55	0.40	22.10
C.D. $_{(0.05)}$	1.29	0.72	0.07		0.72	0.16	0.03	2.65
S.E (+)	0.44	0.24	0.02		0.24	0.06	0.01	0.90

Table.3 Effect of different potting media on leaf characters and partitioning coefficient of air layered litchi plants cv. Dehradun

Treatments	Number of leaves per layer	Increase in total leaf area (cm^2)	Chlorophyll content of leaves (%)	Partitioning coefficient		
				Shoot	Leaves	Root
M_1 : (Soil + Sand + FYM)	19.40	154.30	19.40	31.51	82.90	14.89
M_2 : (Litchi orchard soil + Sand + FYM)	23.00	240.88	23.00	35.66	81.68	15.95
M_3 : (Litchi orchard soil + Sawdust + FYM)	24.60	266.56	24.60	40.84	81.45	16.01
M_4 : (Litchi orchard soil + Sawdust + Vermicompost)	23.80	318.16	23.80	35.38	80.25	17.20
M_5 : (Soil + Rhizobacteria + FYM)	29.20	447.04	29.20	42.83	78.32	18.61
M_6 : (Litchi orchard soil + Rhizobacteria + FYM)	30.60	509.22	30.60	45.96	78.01	18.42
M_7 : (Litchi orchard soil + Neem cake + FYM)	25.33	322.78	25.33	34.45	82.27	14.82
M_8 : (Litchi orchard soil + Perlite + FYM)	27.47	438.51	27.47	41.26	81.08	16.31
M_9 : (Litchi orchard soil + Cocopeat + FYM)	27.40	418.43	27.40	39.93	76.06	21.01
M_{10} : (Litchi orchard soil + Vermiculite + FYM)	25.67	326.74	25.67	40.59	76.11	21.18
M_{11}: (Litchi orchard soil)	20.60	247.54	20.60	34.74	81.08	16.63
M_{12} : (Control)	18.47	152.10	18.47	24.90	86.64	11.55
C.D. $_{(0.05)}$	0.40	2.13	0.40	1.13	3.08	3.51
S.E (±)	0.14	0.72	0.14	0.38	1.04	1.19

Table.4 Effect of different potting media on per cent rooting, root length, root: shoot ratio, survival percentage and relative growth rate of air layered litchi plants cv. Dehradun

Treatments	Per cent rooting	Increase in root length (cm)	Root: shoot ratio	Survival Percentage (%)	Relative growth rate (mg/days)
M_1 : (Soil + Sand + FYM)	82.87	3.47	0.03	64.31	0.70
M_2 : (Litchi orchard soil + Sand + FYM)	82.36	4.27	0.03	76.17	0.95
M_3 : (Litchi orchard soil + Sawdust + FYM)	82.49	4.56	0.03	77.31	0.95
M_4 : (Litchi orchard soil + Sawdust + Vermicompost)	83.39	4.80	0.03	82.39	1.09
M_5 : (Soil + Rhizobacteria + FYM)	81.78	7.01	0.04	90.31	1.22
M_6 : (Litchi orchard soil + Rhizobacteria + FYM)	86.28	9.05	0.05	93.51	1.48
M_7 : (Litchi orchard soil + Neem cake + FYM)	83.42	4.94	0.04	81.45	1.02
M_8 : (Litchi orchard soil + Perlite + FYM)	87.57	5.81	0.03	86.44	1.19
M_9 : (Litchi orchard soil + Cocopeat + FYM)	84.47	5.25	0.04	87.22	1.40
M_{10} : (Litchi orchard soil + Vermiculite + FYM)	86.57	6.03	0.04	88.48	1.33
M_{11}: (Litchi orchard soil)	85.58	4.21	0.03	76.33	0.88
M_{12} : (Control)	80.39	3.02	0.02	52.46	0.39
C.D. $_{(0.05)}$	1.21	1.56	N.S.	2.42	0.16
S.E (±)	0.41	0.53	0.00	0.83	0.05

Per cent rooting

Highest per cent rooting (87.57 %) was recorded in media containing litchi orchard soil along with perlite and FYM which was statistically at par with media having litchi orchard soil in combination with vermiculite and FYM (86.57 %) whereas, the minimum per cent rooting (80.39 %) was recorded in control. The main reason behind the efficient performance of perlite and vermiculite may be due to better soil aeration resulting in

better rooting percentage. If the medium is highly humid, rooting process is delayed as a result of oxygen deficiency which leads to rotting immediately (Erstad and Gislerod, 1994). The results are in conformity with the findings of Isfendiyaroglu *et al.,* (2009), Ansari (2013) and Sardoei (2014) in olive, pomegranate and guava, respectively.

Survival percentage and relative growth rate of litchi air layers

Significantly higher survival percentage (93.51 %) of transplanted rooted layers was recorded in growing media consisting litchi orchard soil in combination with rhizobacteria and FYM whereas, minimum survival percentage (52.46 %) was obtained in control. Chawla (2011) stated that higher survival percentage might be due to the reason that media containing FYM as one of the constituents provided a head start for establishment of rooted layers which further got supplemented by rhizobacteria. Vejan *et al.,* (2016) reported that plant growth promoting rhizobacteria encourage beneficial effect on plant health and growth and accelerate the availability of nutrients and assimilates as well as the production of substances promoting plant growth. Rhizobacteria strains significantly affected plants growth and development by biological nitrogen fixation, by increasing inorganic phosphate solubilization of organic phosphorus compounds, by secreting iron-chelating compounds (siderophores) and by affecting the uptake, absorption and translocation of micronutrients (Esitken*et al*., 2003; Cakmakci*et al*., 2006 andAslantas*et al*., 2007) and hence, better survival percentage.

The maximum relative growth rate (1.48 mg/days) was recorded in media having litchi orchard soil in combination with rhizobacteria and FYM while, minimum relative growth rate (0.39 mg/days) was observed in control. Klopper *et al.,* (1980) and Frommel *et al.,* (1993) stated that plant growth promoting rhizobacteria rhizosphere colonization resulted in early formation of stolon and tubers as well as increases the stolon length and yield in potato. These results are also in conformity with the findings of Kloepper and Schroth (1981) in radish who suggested that plant growth promoting rhizobacteria increase plant growth indirectly by interacting with the native root microflora.

From the present study, it can be concluded that among the different potting media, litchi orchard soil in combination with rhizobacteria and FYM is found to be superior for enhancing the survival and growth of litchi air layers in terms of plant height, growth parameters of shoot, root and leaves.

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